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May 1988

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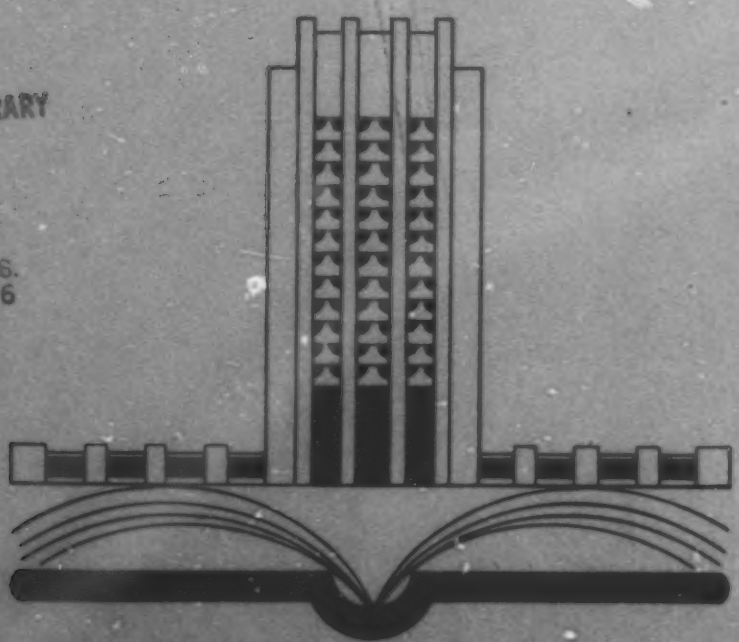

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SPECIAL REFERENCE BRIEF

FLUID DRILLING AND SOIL CONDITIONING USING HYDROPHILIC POLYMERS

May 1988 NAL-SRB 88-07

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Technical Services Division, in
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FLUID DRILLING AND SOIL CONDITIONING USING HYDROPHILIC POLYMERS

With applications as diverse as cosmetics, foods, oil drilling, and drug delivery, hydrophilic (water-loving) polymers have become an integral part of modern technology. Wherever water or aqueous solutions must be controlled, they are likely to be present. Their ability to dissolve in or bind water combined with their high molecular weight provides a mechanism for increasing the viscosity of aqueous fluids from a slight thickening to complete gelation, in which the fluid is quite immoblile. These polymers can also serve to improve the physical properties of aqueous suspensions or aggregates. Most importantly, all of these benefits are possible at extremely low levels of polymer addition - often well below one weight percent of the fluid to be controlled - so their use is quite cost-effective. Both the chemistry (1) and applications (2) of these polymers have been comprehensively reviewed.

Two agricultural applications of hydrophilic polymers are of increasing research and practical interest; broadly defined for the purposes of this bibliography, the division between them is in some cases arbitrary:

Fluid drilling is a technique in which pregerminated seeds are suspended in a gel carrier consisting of water containing dissolved polymer, often along with fertilizers or other additives such as plant growth regulators or fungicides. This mixture is then extruded into the growth medium. The advantages of sowing already germinated seeds in a complete "package" can include earlier, higher, and more uniform emergence compared to dry seeds. This technique has required the development of new machinery for sowing the gel suspension. Gray (3) has reviewed and provided references on the background and development of fluid drill planting.

Fluid drilling has also been investigated as a means of delivering other additives, such as biological control agents, directly to soils. Similarly, the moisture-holding capacity of gels has been exploited to increase the survival of nematodes used to kill citrus root weevils, according to a recent press report (4).

Related to fluid drilling is the use of hydrophilic polymers or gels as root or seed coatings. Again, localization of water and nutrients can improve germination, seedling survival, or transplant establishment.

Soil conditioning by hydrophilic polymers takes several forms. Recent advances in polymer production and application have revived interest in the use of soluble polymers for the improvement of the physical properties of soils. Very low application rates can prevent soil crusting, reduce erosion, increase porosity, and improve water infiltration, for example. The articles by Wallace (5) and Page (6) summarize these developments.

Water-soluble polymers can be chemically modified (crosslinked) so that rather than dissolve, they will swell to absorb large amounts of fluid and form a gel, essentially water held in a fine polymer network (7). Such gels have the ability to both release and reabsorb water depending on external conditions. Generally requiring higher application rates than soluble polymers, these gels can be used to reclaim and improve moisture storage in sandy soils. Azzam's review (8) contains 500 references to the literature of polyacrylamide, an important member of this group.

Hydrophilic gels have also attracted attention as horticultural media amendments. Irrigation needs can be reduced and nutrient availability improved; the swollen polymer can act as a water reservoir. Under investigation and in use for some time in the research and commercial arena, these compounds are now becoming available to the home gardener as well (9).

The purpose of this bibliography is to list (as of April 1988) selected post-1979 English language references from the AGRICOLA database in the areas of fluid drilling and soil conditioning as discussed above. The fluid drilling section updates NAL Quick bibliography 84-02.

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